CLAIMS

What is claimed is:

1. In an implantable cardiac stimulation device, a method for determining an atrial rate comprising:

tracking refractory periods within atrial and ventricular channel signals sensed using a non-combined unipolar/bipolar sensing technique;

comparing a previously determined atrial rate against a predetermined threshold set below an atrial tachycardia detection threshold (ATDR) rate for the purposes of determining an atrial rate determination technique for updating the atrial rate; and

if the previously determined rate does not exceed the threshold, updating the atrial rate based on events detected via non-combined unipolar/bipolar sensing; and

if the previously determined rate exceeds the threshold, updating the atrial rate based on events detected using combined unipolar/bipolar sensing.

2. The method of claim 1 wherein the non-combined unipolar/bipolar sensing technique is unipolar.

3. The method of claim 1 wherein the non-combined unipolar/bipolar sensing technique is bipolar.

4. The method of claim 1 wherein the predetermined threshold is 20 - 30 beats per minute (bpm) less than the ATDR.

5. The method of claim 1 wherein comparing the previously determined atrial rate to a rate threshold for the purposes of selecting the

atrial rate determination technique is only performed if automatic mode switch (AMS) is enabled in the implantable stimulation device or if an atrial high rate detection diagnostic event counter is enabled, otherwise the atrial rate is only updated based on events detected outside the refractory periods via non-combined unipolar/bipolar sensing.

6. The method of claim 1 wherein updating the atrial rate based using a combined unipolar/bipolar sensing technique comprises:

detecting P-waves using combined unipolar/bipolar sensing and determining whether all detected P-waves are deemed to be true P-waves according to a combined unipolar/bipolar sensing logic;

if so, updating the atrial rate using events detected using combined unipolar/bipolar sensing without adjustment of the ventricular sensitivity until the rate falls below the first threshold then resuming non-combined unipolar/bipolar sensing; and

if not, then increasing the sensitivity on the ventricular channel while also shortening the ventricular refractory period and opening the ventricular refractory period to sensing to re-assess the detection of P-waves.

7. The method of claim 6 wherein re-assessing the detection of P-waves comprises:

determining whether all previously detected P-waves are still deemed to be true P-waves despite the modifications in ventricular sensitivity and ventricular refractory period duration; and

if so, updating the atrial rate using combined unipolar/bipolar sensing with adjusted ventricular sensitivity and ventricular refractory period duration but only until the rate falls below the first threshold, then resetting the ventricular sensitivity

and the ventricular refractory period duration and resuming non-combined unipolar/bipolar sensing; and

if not, updating the atrial rate using combined unipolar/bipolar sensing with adjusted ventricular sensitivity and ventricular refractory period duration to determine whether the rate exceeds a second, higher threshold.

8. The method of claim 6 further comprising of increasing a ventricular sensitivity to be at least equal to that of an atrial sensitivity.

9. The method of claim 6 further comprising switching from a tracking mode to a nontracking mode if the atrial rate exceeds the second, higher threshold.

10. The method of claim 6 further comprising initiating an atrial high rate diagnosis procedure if the atrial rate exceeds the second, higher threshold.

11. The method of claim 1 wherein the implantable cardiac stimulation device is coupled to unipolar leads and wherein updating the atrial rate based on events detected using combined unipolar/bipolar sensing comprises:

identifying events sensed only on the atrial channel as being true atrial events and counting the event for the purposes of atrial rate calculation;

identifying events sensed simultaneously on the atrial and ventricular channels as being a ventricular event and ignoring for the purposes of atrial rate calculation; and

identifying events sensed only on the ventricular channel as being noise and ignoring for the purposes of atrial rate calculation.

12. The method of claim 1 wherein the implantable cardiac stimulation device is coupled to bipolar leads and wherein updating the atrial rate based on events detected using combined unipolar/bipolar sensing comprises:

detecting R-waves on the ventricular channel;

detecting candidate P-waves on the atrial channel;

determining whether the candidate P-waves occur within a first period of time bracketing detected R-waves; and

if not, concluding the candidate P-waves are true P-waves; and

if so, increasing a sensitive on the ventricular channel to equal a sensitivity on the atrial channel during the period of time bracketing the R-waves and determining R-waves are detected on the ventricular channel within a second, shorter, period of time bracketing the P-waves.

13. The method of claim 12 further comprising:

concluding that the candidate P-waves are true P-waves if R-waves are not detected on the ventricular channel within the second, shorter, period of time bracketing the P-waves; and

concluding that the candidate P-waves are false P-waves otherwise.

14. The method of claim 12 wherein the first period of time bracketing detected R-waves is about 400 milliseconds (ms) and the second period of time bracketing the P-waves is about 50 ms.

15. In an implantable cardiac stimulation device, a system for determining an atrial heart rate comprising:

means for monitoring the atrial rate and for comparing the rate to a first threshold;

means, operative in response to the atrial rate exceeding the first threshold, for enabling combined unipolar/bipolar sensing and updating the atrial rate;

means for comparing the updated atrial rate against a second threshold, higher than the first;

means, operative in response to a determination that the updated rate exceeds the second threshold, for concluding that an atrial tachycardia has occurred.

16. In an implantable cardiac stimulation device, a system for determining an atrial rate comprising:

an atrial rate determination unit operative to selectively determine an atrial rate using either bipolar sensing or combined unipolar/bipolar sensing; and

a control unit operative to compare the atrial rate determined using bipolar sensing to a first threshold and, if the atrial rate exceeds the first threshold, to control the atrial rate determination unit to update the atrial rate using combined unipolar/bipolar sensing.

17. In an implantable cardiac stimulation device, a method for determining an atrial rate comprising:

a control until operative to track refractory periods within atrial and ventricular channel signals sensed using a non-combined unipolar/bipolar sensing technique and operative to compare a previously determined atrial rate against a predetermined threshold for the purposes of determining an atrial rate determination technique for updating the atrial rate; and

an atrial rate determination unit operative, if the previously determined rate does not exceed the threshold, to update the atrial rate based on events detected via non-combined unipolar/bipolar sensing and operative, if the previously

determined rate exceeds the threshold, to instead update the atrial rate based on events detected using combined unipolar/bipolar sensing while selectively resetting a ventricular channel sensitivity during the ventricular refractory period.

18. In an implantable cardiac stimulation device, a method for determining an atrial heart rate comprising:

monitoring the atrial rate and comparing the rate to a first threshold set below an atrial tachycardia detection rate (ATDR) threshold;

if the atrial rate exceeds the first threshold, enabling atrial combined unipolar/bipolar sensing and adjusting the atrial rate; and

comparing the adjusted atrial rate against a second threshold, higher than the first and, if the adjusted rate exceeds the second threshold, concluding that an atrial tachycardia has occurred.